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Empirical Evidence of the Effects of Public Spending on Economic Growth from BRICS

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by

Nkateko Mokoena

(MKNNKA002)

Supervisor: Dr Abdul Latif Alhassan

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Name: Nkateko Mokoena
Student Number: MKNNKA002
Course: Mcom Development Finance

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ABSTRACT

The topic of the impact of government spending on economic growth has previously been extensively researched, however the evidence is inconclusive to make a ruling. The purpose of this study was to examine the empirical relationship between government spending and economic growth for the BRICS (Brazil, Russia, India, China and South Africa) over the period 1994-2014 by observing GDP as the dependent variable and Education, Health, Infrastructure and Defense as the independent variables. The study was based on panel data analysis of data obtained from secondary sources. The analysis process began with summarizing the data using descriptive statistics. Following this was the process of regression analysis in order to determine the relationships between GDP and Health, Education, Defense and Infrastructure. We checked for Multicollinearity using Variance Inflation Factors (VIF's) and used the Hausman Test to determine which statistical model to use. The study followed the fixed effects statistical model. The empirical results support the null hypotheses that health, education and defense have a long-tern relationship with GDP. The study however found that there was no long-term relationship between GDP and infrastructure.

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CHAPTER 1: INTRODUCTION

1.1 Background of study

The relationship between economic growth and government spending has been the subject of thought-provoking debates between scholars and policymakers over the years. While some scholars are advocates of investment in government spending to increase economic growth, others might argue that government spending needs to be financed, mostly from taxes that are paid for by the citizens of the country. An increase in public spending will result in a decrease in the demand for goods and services because citizens will not be able to afford them. This will increase the government's need to increase its social public expenditure in order to provide for its citizens. Economies facing such a dilemma will find it difficult to thrive and maintain sustainable growth.

Government spending is thought to include outlays of the national government, provincial government and local authorities, and budgetary institutions (Alagidede, 2012). "Economic growth is a sustained expansion of production possibilities measured as the increase in real gross domestic product (GDP) over a given period. Rapid economic growth maintained over a few years can transform a poor nation into a rich one" (Parkin et al., 2010, p. 480). Economic growth is measured as a percentage increase in real GDP per capita.

This study will investigate national government spending in BRICS (Brazil, Russia, India, China and South Africa) during the period 1994 to 2014. The rationale behind the selection is that these are the fastest-growing countries with emerging economies, and the engines of the global recovery process, which underscore the changed role of these economies. Collectively, they encompass over 40% of the world's population and account for nearly 25% of the total GDP in terms of purchasing power parity. The period under investigation is of significance because in this time, BRICS experienced momentous economic reform and rapid economic growth (Singh and Dube, 2012).

During the 2000s, decisive pro-poor policies succeeded in reducing poverty in Brazil while Russia managed to recover in terms of economic growth, poverty reduction and improved life expectancy after a rather painful decade in the 1990s. China and India, known as the Asian Giants, also experienced growth, increased health outcomes and poverty reduction. South Africa underperformed in terms of economic growth and human development, with a further

decline in life expectancy at birth due to widespread HIV/AIDS infection; however, it succeeded in reducing extreme poverty (Reisen).

Although these countries have different political systems and governments, these systems and governments have played a major role in internal growth and development processes. A common challenge faced by the BRICS economies is the need for institutional development without which sustainable growth cannot be achieved. Policy changes need to address both domestic and external challenges.

1.2 Problem definition

The problem being addressed in the study is that economists are divided in their views of the factors that stimulate economic growth. Economic growth is complex to measure because several factors can contribute to the growth process. Theoretical predictions regarding factors that make countries richer are not based on consistent empirical confirmation. There are many exceptions to the idea that human capital is the only factor that is important for economic growth. Countries such as Poland, Russia and South Korea have education levels that are very close to those in the richest economies; however, their GDP per capita is much lower (Tridico, 2006). The relationship between government spending and economic growth can be either negative or positive based on the data sets and various econometric elements used to analyse the data. The purpose of this study is to fill the gap within already existing knowledge. The study will follow on Barro's empirical growth model using panel analysis data from BRICS.

The BRICS group of countries are estimated to become the world's most important economies by 2050. Their economic importance will lead them to be the focus in the Organisation for Economic Co-operation and Development (OECD). China is predicted to dominate the manufactured goods industry, while India is likely to control services. Russia and Brazil will head up the raw material supplies sector. South Africa, on the other hand, could emerge as the leading mineral supplier (Singh & Dube, 2012). Tridico (2006) states that to explain economic growth, focus needs to shift to the interaction between some socio-economic factors and institutional indicators. He explains that it is only when institutions – which provide proper governance and incentivise economic agents – foster positive interaction with other socio-economic variables will economic growth be realised.

1.3 Statement of research objectives and hypotheses

The main objective of the study is to investigate the impact of public spending on economic growth in BRICS in the following specific areas:

- education
- health
- defense
- infrastructure

Hypotheses

1. Null hypothesis

Ho: Health expenditure does not have a long-term relationship with GDP

Ha: Health expenditure has a long-term relationship with GDP

2. Null hypothesis

Ho: Education expenditure does not have a long-term relationship with GDP

Ha: Education expenditure has a long-term relationship with GDP

3. Null hypothesis

Ho: Defense expenditure does not have a long-term relationship with GDP

Ha: Defense expenditure has a long-term relationship with GDP

4. Null hypothesis

Ho: Infrastructure expenditure does not have a long-term relationship with GDP

Ha: Infrastructure expenditure has a long-term relationship with GDP

1.4 Justification

Poverty eradication is one of the Millennium Development Goals and governments need to play a major role in creating pro-poor policies that will enhance growth and development. There isn't enough empirical evidence of economic growth from BRICS. This study incorporates empirical and theoretical analysis on how BRICS managed to grow their economies rapidly. The benefit of the study to government stakeholders is to provide guidance in formulating pro-growth policies that prioritise the allocation of government expenditure, particularly to areas that are conducive to economic growth and development. Due to the

inconclusiveness of previous tests on the subject, this study also assists in filling the gap in knowledge about the impact of public spending on economic growth in emerging economies.

1.5 Organisation of the study

The study is divided into five chapters. Chapter 1 gives the background and justification of the study. The second chapter focuses on existing theories based on the study as well as a review of the literature. Methodology forms Chapter 3, followed by research findings and analysis in Chapter 4. To conclude, recommendations based on the findings in prior chapters and policy implications are discussed in Chapter 5.

CHAPTER 2: LITERATURE

2.1 Introduction

Governments that use public expenditure effectively can lay the foundation for more sustained economic growth and development in the long term. Steps can be taken to improve citizens' standard of living and to eradicate poverty as far as possible. The previous chapter provided an introduction and background to the study. The first part of this chapter discusses some of the relevant theories on the subject. This is followed by a review of the empirical literature. Finally, a summary of both theoretical and empirical analyses is provided.

2.2 Theoretical framework

The many various theories of economic growth have been adopted as models to assist governments to establish economic policy. These include:

2.2.1 Wagner's law

Adolf Wagner was a German economist who introduced Wagner's law, a theory that suggests that increased public expenditure results in increased productivity, leading to economic growth. The focus of the theory is on the relationship between the size of the economy and the size of the public sector. As the economy develops, the activities and functions of the government increase (Wagner, 1883).

Wagner examined three main reasons for increased government involvement. First, he looked at how industrialisation and modernisation would lead to substitution of public and private activity. He stated that there would be a need for public protective and relative activity to grow in a complex society. Secondly, Wagner argued that the growth in income would facilitate the relative expansion of income-elastic cultural and welfare expenditures. Finally, he stated that economic development and changes in technology required government to take over the management of natural monopolies in order to enhance economic efficiency (Henrekson, 1993).

2.2.2 The Keynesian view

The Keynes's theory, which has come to bear his name, is the assertion that aggregate demand – measured as the sum of spending by households, businesses, and the government – is the most important driving force in an economy. Keynes further asserted that free markets have no self-balancing mechanisms that result in full employment. Keynesian economists justify government intervention through public policies that are aimed to achieve full employment and price stability (Jahan, Mahmud, & Papageorgiou, 2014).

The Keynesian view suggests that public spending can be utilised as an instrument to influence government fiscal policy and thus create economic growth. The model argues that an increase in public spending causes an increase in aggregate demand and consumption, resulting in increased consumption. When an economy is in a recession, government can borrow funds from the private sector and repay it through various spending programmes (Keynes, 1936).

2.2.3 Endogenous growth

Robert Barro was among the first macroeconomists to endorse endogenised public spending. Endogenous growth suggests that public spending, particularly on physical infrastructure or education, enhances economic growth. Barro categorised public expenditure into productive and non-productive expenditure. Productive expenditure is viewed as growth-promoting while non-productive expenditure is growth-retarding. (Barro, 1990).

2.2.4 Solow's view

Solow (1956) developed the neoclassic theory that suggests sustained increases in capital investment will only temporarily increase economic growth. Countries that seek to enjoy growth in the long run will need to drive technological change and increase their labour force. The model further stipulates that fiscal policies related to taxation and public spending can affect the level of income in the short run but has no impact on the long run rate of economic growth.

2.2.5 Romer's view

Romer (1990) stipulates that government plays a role economic growth. He further recommends deliberate investment in technological advancement in order to drive growth in

the long run. The main distinguishing feature of technology as an input is that it is not a public good but a non-rival, partially excludable good. The nonconvexity of a non-rival good ensures that price taking competition cannot be supported, instead the equilibrium is the one with monopolistic competition.

2.3 Empirical studies

Menyah and Wolde-Rufael (2013) investigated the long-run and causal relationship between government expenditure and economic growth in Ethiopia using Wagner's law. The investigation was conducted for the period 1950-2007. The evidence suggested that government expenditure was not used as an effective policy instrument for fostering economic growth in Ethiopia. A similar study by Katrakilidis and Tsaliki (2009) on the Greek economy covering the period 1958-2004 was conducted. The results indicated a positive and statistically significant long-run causal effect leading from income towards government spending.

Cashin (1995) developed an endogenous model of the influence of public investment, public transfers and distortionary taxation on the rate of the economy. The model was tested with 23 developed countries for the period 1971-1988. The policy implications arising from the paper were that increased government spending on those items that enter private production function as productive public inputs enhancing economic growth.

Devarajan, Swaroop and Zou (1996) conducted a study to determine if there was a link between the various components of government spending and economic growth in developing countries. They used data from 43 developing countries over a period of 20 years. Their model highlighted the differences between productive and non-productive government expenditure. They found that increasing productive expenditure results in positive and significant growth. In a similar study, Bojanic (2013) investigated the relationship between economic growth and government spending on health, defense, education and infrastructure in Bolivia. The results indicated that expenditure on education and in other promising departments had the potential to generate significant growth and should be considered areas for possible government intervention.

Birdsall (1996) discussed the benefits of public spending on higher education over lower levels of education. She asserted that there might be a case for maintaining or even increasing spending on higher education, provided public funds can be directed around research and other public good functions of the institutions of higher education. Deskins, Hill and Tuttle (2008) conducted a study on a panel of state-level data for all states spanning the period 1977-2003.

The results suggested a bi-causal relationship since education spending responds positively to changes in state income. They further found that there is no short-run relationship between education spending and state GDP.

Irmen and Kuehnel (2009) examined the possible links between government spending and productive government activity based on Barro's endogenous growth models. The study was based on 19 OECD countries over the period 1995-2002. Irmen and Kuehnel argued that, although previous research incorporated relevant aspects, future research should focus more on idea-based endogenous growth models to check the robustness of policy recommendations. They found that if productive government services are provided in a non-scale model, they stop influencing the steady-state growth rate.

A study by Zagler and Durnecker (2003) presented a unifying framework for the analysis of long-run growth implications of government expenditure on revenues. A distinction was made between productive (growth-enhancing) and unproductive (consumptive) expenditure. Zagler and Durnecker found that infrastructure investment and education expenditure exhibited a direct impact on the growth rate of the economy. Whenever the level of education exceeds the level of knowledge or innovation, a positive impact on economic growth is obtained. Akitoby, Clements, Gupta and Inchauste (2006) examined the short- and long-term behaviour of government spending in 51 countries using an error correction model. They found evidence that is consistent with the existence of cyclical ratcheting and voracity in government spending for developing countries that results in a tendency for government spending to rise over time.

Chen (2006) used a one-sector endogenous growth model to study optimal composition between public investment and consumption in government spending and economic growth. The results suggested that the growth effect is sizeable and that economic factors which affect economic growth in conventional wisdom, now yield stronger growth effects from governments' optimal response through its spending share adjustments between productive and consumptive service.

A further study by Agenor and Neandis (2011) was based on the allocation of government spending on health, education and infrastructure in an endogenous growth framework. This framework accounts for the complementarities emphasised by microeconomic evidence and the aggregate budget constraint faced by policymakers. Agenor and Neandis's study also suggested that, at the microeconomic level, the relationship between health, education and

infrastructure services is complementary. At the macroeconomic level, however, there are some potential trade-offs that may emerge between the provision of various categories of services, which often fall under the responsibility of the state (at least in most low- and middle-income developing countries). Canning and Pedroni (2004) also found that there is a positive relationship between government spending and investment in infrastructure.

Using panel data from a sample of 24 Chinese provinces for the period 1985-1998, Demurger (2001) conducted a study to establish links between infrastructure investment and economic growth in China. The focus of the study was on the role of transport equipment in growth differentials. The study followed on the now-standard Barro-type framework and the results indicated that transport facilities are a key differentiating factor in explaining the growth gap and point to the role of telecommunications in reducing the burden of isolation. Bloom, Canning and Sevilla (2004) used a panel of countries observed every 10 years over the period 1960-1990 with the focus being on health. They found that good health has a positive and significant effect on aggregate output. Hy (2011) found a positive relationship between public spending and health care in 11 public health regions in Texas. The study also recognised health care as an investment that returns continual dividends in the form of better jobs, higher incomes and additional state and local tax revenues.

Ghosh and Gregoriou (2008) used a panel of 15 developing countries over 28 years to examine the link between components of government spending and growth. Their results suggested that spending on health and education had a negative impact on the growth rate. They further stated that this could be the result of distorted incentive structures, bureaucratic inefficiencies and/or corruption and the fact that goods produced from public spending turned out to be of poor quality.

Bucci and Bo (2012) extended Barro's model to examine the role of productive government activity in long-run optimal growth. Barro (1990) viewed public expenditure as a flow variable while Bucci and Bo examined public expenditure as a stock variable. They also studied the effect that a change in the degree of complementary/substitutability between the two capital goods in output production may have on the optimal growth rate on the economy. Their findings suggested that with exogenous allocation of public capital to final output production, the main determinant of optimal growth is the level of complementarity or substitutability between private and public capital investments. This is irrespective of the aggregate technology

for goods production. However, with endogenous allocation of public capital to final output production, optimal growth increases inputs in the production of final output.

Following on the Barro model, Arai (2011) analysed the effects of a change of public spending/GDP on fiscal sustainability and welfare. The results displayed a hump-shaped relationship between public-spending/GDP ratio and fiscal sustainability. If that ratio is small (large), raising it leads to a more (less) sustainable fiscal policy. However, the output-growth-maximising fiscal policy does not always make public debt sustainable. This means that the growth-maximising fiscal policy may involve too large a public-spending GDP ratio to sustain public debt.

Makuta and O'Hare (2015) conducted an analysis using panel data on 43 countries in Sub-Saharan Africa for the period 1996-2011. They used a two-stage least squares regression technique to estimate the effect of public spending on health and the quality of governance in under-five mortality and life expectancy. They found that public spending on health has a statistically significant impact on improving health outcomes. Furceri and Zdzienicka (2012) evaluated the short-term effects of social spending on economic activity using a panel of OECD countries from 1990 to 2005. Their results indicated that spending had expansionary effects on economic activity. Social spending on health and unemployment benefits had the greatest effects. Apergis and Padhi (2013) explored the role of public spending on public health across 26 Indian states spanning the period 1981-2005 using the Phillips and Sul methodology. The results suggested that increasing investment and spending in the health sector is necessary through direct intervention policies or by increasing the economy's income across the states.

Using state-level data from 1970 to 1993, Fan, Hazell and Throat (2000) developed a model to test the direct and indirect effects of the different types of government expenditure on rural poverty and productivity growth in India. They found that spending on productivity-enhancing investments and rural development targeted directly at the rural poor has contributed to reductions in poverty as well as to growth in agricultural productivity.

Esfahani and Ramirez (2003) examined the impact on economic growth of spending on infrastructure in 75 OECD countries over a period of 30 decades. The results shed light on the factors that shape a country's response to its infrastructure needs and offered policy implications for facilitating the removal of infrastructure inadequacies.

Farhadi (2015) examined the growth impact of public infrastructure in a panel of 18 OECD countries from 1870 to 2009. The results demonstrated that growth in both labour productivity and total factor productivity are positively, but not substantially, influenced by growth in the stock of infrastructure. Farhadi noted that applying the generalised method of moments technique reveals that, although rate of returns to investment to infrastructure exceeds the private rate in OECD countries, it is not as high as positive externalities associated with investment equipment and structure investment.

Shi, Gou and Sun (2017) investigated the relationship between infrastructure capital (electricity generating capacity, roadways, railways and telecommunications) and China's regional economy over the period 1990-2013. They reviewed panel data on 30 of the provinces and municipals using the vector error correction model. Their results showed that massive infrastructure spending does not always translate to faster growth and that over investment can be detrimental to growth.

Baldacci, Clements, Gupta and Cui (2004) investigated the role of human capital in fostering economic growth. Using the econometric approach based on panel data regressions, their focus was on a system of four equations, namely, real per capita income growth, total investment, education attainment, and health status. They used panel data from 120 developing countries from the period 1975 to 2000. The main results revealed that both education and health capital contribute positively to output growth but through slightly different routes. Education displayed both an immediate and a lagged effect on capital while health spending showed a positive and significant impact on health capital. However, opposing results were found by other researchers. A study by Benhabib and Spiegel (1994) used cross-country estimates of physical and human capital. They ran a growth accounting regression implied by the Cobb-Douglas aggregate production function and found that the role of education in economic growth rates was weak. Pritchett and Summers (1996) investigated the effects of income on health using cross-country time series data on health and income per capita. The results revealed that during the 1990s, over half a million child deaths in developing countries were because of poor economic performance experienced in the 1980s.

Andrés, Doménech and Fatas (2004) investigated the role of macroeconomic volatility on government size. The study focused on alternative models of the business cycle and how these can replicate the stylised fact that economies with large governments are less volatile. Government size is measured by the log of the GDP share of total government expenditures.

The result of the study demonstrated that larger governments do, indeed, have less volatile business cycles. The volatility of consumption increases as the government size increases. Larger governments reduce the volatility of output due to a composition effect because government spending is not volatile, the size of the GDP component of GDP.

Nurudeen and Usman (2010) conducted a study to investigate the impact of government expenditure on economic growth in Nigeria using a disaggregated analysis. Based on data observed between 1970 and 2008, they found that government expenditure on education had a negative impact on economic growth while government expenditure on transport and health had a positive impact on economic growth. Torruam, Chiawa and Abur (2014) also investigated the impact of public expenditure on tertiary education in Nigeria. They used time series data for the period 1990-2011 and found that public expenditure on tertiary education has a positive impact on economic growth in Nigeria.

In a study carried out by Cappelen, Gleditsch and Bjerkholt (1984) on military spending, the researchers found a positive impact on economic growth. Another study carried out by Azfar Anwar et al. (2012) on defense spending in Pakistan used time series data from 1980 to 2010. They applied the Johansen cointegration and Granger causality tests. The results showed that there is a long-run relationship between defense spending and economic growth and that economic growth granger causes defense spending. Heo (2010) applied the Feder-Ram and augmented Solow models to test defense growth in the United States for the period 1954 to 2005. The results indicated that defense spending did not significantly affect economic growth.

Dunne and Smith (1993) investigated whether observed government expenditures are consistent with optimising behaviour in Australia, Portugal, Sweden and the U.K. In this study, expenditures are treated as intermediate goods producing desired outputs (e.g. health, education, security) conditional on demographic variables. These were estimated using the Deaton-Muellbauer AIDS system on time series data for four categories of expenditure in each country and the restrictions tested, with both homogeneity and symmetry being accepted for Sweden. The results suggested that given the widespread result from static private consumption studies, symmetry and homogeneity are rejected.

Dunne, Nadir and Mohammed (1995) conducted a study to investigate the economic effects of military expenditure in less-developed economies. Their study focused on thirteen

homogeneous Sub-Saharan African over the period from 1967 to 1985. The econometric analysis used data for the group of countries as a whole, a cross-sectional analysis of the country averages, and an analysis of the pooled country data. The results suggested that economic factors play an important role in determining the level of military burden across countries and over time for the sample as a whole. A time-series analysis on military expenditure is also found to have a negative effect on economic development for the countries as a whole, through its negative indirect effects on human resource accumulation, investment allocations and the balance of payments. Both these results show the value of attempting to capture both time-series and cross-sectional effects when analysing the determinants and economic effects of military spending.

Dunne and Vougas (1999) conducted an analysis of the relationship between economic growth in South Africa over the period 1964 to 1996. To achieve this, a development of the standard Granger causality tests within the VAR framework was used. The standard techniques found no significant relationship, however, the inclusion of long-run information by taking cointegration into account provided a significant result.

Dunne, Nikolaidou and Smith (2002) carried out a study to investigate the growth and investment equations for a range of small-industrialising economies for the period 1960-98. The study used panel data methods and investment was used as a function of growth and expenditure. The results suggested some evidence of a negative impact of military spending on growth and investment.

2.4 Summary of literature

Based on existing theoretical and empirical evidence, there is no consistency on significant relationships between public spending and economic growth. The results seem to fall on either a positive or negative relationship based on country selection, different data sets and various econometric approaches.

CHAPTER 3: METHODOLOGY

3.1 Introduction

The preceding chapter reviewed literature relevant to this study. This chapter will focus on the research methodology used in the study. Based on the empirical nature of this study, quantitative research has been conducted. The empirical research was based on panel data for BRICS for the period 1994-2014. The research investigated the level of real GDP per capita for BRICS based on productive (infrastructure) and non-productive (education, health, defense) components of public spending.

3.2 Sample size and data period

Secondary data obtained from the World Bank and International Monetary Fund were used to analyse the effects of public expenditure on economic growth in BRICS for the period 1994-2014. GDP per capita data as well as data on education, health, defense and infrastructure were analysed to reach the conclusion.

The data used in this study were collected over a period from 1994 to 2014 for the BRICS countries. The data constituted the following variables: GDP, and health, education, defense and infrastructure expenditure.

Panel data, also called longitudinal data or cross-sectional time series data, is data where entities (panels) such as people, firms and countries are observed and measurements taken at multiple time points (Dale, Wathan & Higgin, 2008). Panel studies allow the researcher to find out why changes in the population are occurring since they use the same sample of people or population elements every time data is collected. In this study, states (countries) were the entities since the data on the study variables were observed and recorded for every state annually. Hence, State was the panel variable.

3.2.1 Data analysis

Descriptive statistical analysis was done to obtain the mean and standard deviation for the numerical data (Johnston, 1995). For inferential analysis, panel data analysis – which can also be referred to as time series regression analysis – was done to determine the relationships between GDP and health, education, defense and infrastructure.

Regression analysis helps in understanding how a value of the dependent variable changes when the value of the independent variable is varied. Regression analysis is widely used for modelling the data generating process, prediction or forecast. It enables the researcher to understand which among the independent variables are related to the dependent variable and to explore the forms of these relationships. In the multiple regression models, there are p independent variables:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_p X_p + \varepsilon$$

Where Y is the dependent variable (that is, GDP), β0 is the intercept; βi's (i = 0, 1, 2,.., p) are the coefficients; the effects of the independent variables on the dependent variable, $X_1, X_2, ..., X_p$, are the independent variables (that is, health, education, defense and infrastructure expenditure); and ε is the random error.

Regression analysis was used, as the intention of this study was to find out how and whether there was a significant correlation and long-term relationship between GDP and the above-mentioned independent variables. A panel analysis regression model was fitted on GDP and the independent variables. Pearson correlation was used to assess the significant correlations between GDP and the independent variables. The Pearson correlation coefficient is used to indicate the strength of a linear relationship between two variables, but its value generally does not completely characterise their relationship (Johnston, 1995). One should also check for multicollinearity using variance inflation factors (VIFs); however, where independent variables show high VIF, they should not be used. Since regressions can be subject to criticisms regardless of the outcome of tests it is preferable to exclude some variables and add control dummies rather than the other way around. The goodness of- fit of the models was checked for adequacy using appropriate diagnostic methods (that is, plotting the residuals of the model), and differences at $P < 0.05$ to be regarded as statistically significant.

3.3 Analytical framework

3.3.1 Regression equation

Real GDP is the dependent variable while the productive (infrastructure) and non-productive factors (education, health and defense) form part of the explanatory variables in the regression equation:

$$GDP_{i,t} = \beta_0 + \beta_1 INF_{i,t} + \beta_2 EDU_{i,t} + \beta_3 HEA_{i,t} + \beta_4 DEF_{i,t} + \varepsilon_{i,t}$$

Here, i and t denote countries and years respectively; GDP is Gross Domestic Product; INF denotes infrastructure; EDU represents education; HEA is health; DEF is defense expenditure and GOV denotes governance. ε is the standard error term.

3.3.2 Description of variables

This section provides the description, measurement and theoretical discussions of the linkages between the independent variables and the dependent variable in the regression equation.

3.3.2.1 Gross domestic product (GDP)

GDP measures the monetary value of final goods and services that are bought by the final consumer and produced in a country in a given period of time calculated over a quarter of a year. It takes into account all of the output generated within the borders of a country. GDP is made up of goods and services produced for sale in the market and also includes nonmarket production, such as defense or education services provided by the government (IMF, 2018).

Government spending for the independent variables is determined as follows: infrastructure consists of capital expenditure that is measured through the development of transportation, communication, electricity and waterways. Education consists of current and capital expenditure spent by governments on primary through to tertiary education, measured as the total current and capital expenditure on education. Health consists of current and capital expenditure on hospitals, clinics, medication, and medical and dental services. Defense expenditure consists of public spending on the administration, supervision and operation of military defense affairs and forces (Kambua, 2014).

3.3.2.2 Infrastructure (INF)

(Hansen, 1965) differentiates between the two types of infrastructure: Economic infrastructures are the ones that directly support productive activities such as roads, highways, airports, naval transport, sewer networks, aqueducts, networks for water distribution, gas networks, electricity networks, irrigation plant and structures dedicated to the commodities transfer. Social infrastructures are those finalized to increase the social comfort and to act on the economic productivity. They include schools, structures for public safety, council flat (not referable to expenses of economic nature), plant of waste disposal, hospitals, sport structures,

green areas, and so on. The theoretical literature suggests that investment in infrastructure is likely to raise the marginal product of private capital used in production (Barro, 1990).

3.3.2.3 Education (EDU)

Education expenditure includes direct expenditure on educational institutions as well as educational-related public subsidies given to households and administered by educational institutions. This indicator is represented as a percentage of GDP, split between primary, primary to post-secondary non-tertiary and tertiary levels. Public spending comprises of expenditure on schools, universities and other public and private institutions delivering or supporting educational services. This indicator shows the priority that governments allocate to education relative to other areas of investment, such as health care, social security, defense and security. Public spending on expenditure covers expenditure on schools, universities and other public and private institutions delivering or supporting educational services. OECD (2020)

3.3.2.4 Health (HEA)

Endogenous growth models highlight the importance of human capital on economic growth and development. Health is considered to be an important determinant of economic development; a healthy population means higher productivity, thus higher income per head. The importance of human capital to economic growth is essential because it serves as a catalyst to economic development. Health is considered to be capital; therefore, investments on health can lead to an increase in labour productivity, further resulting in an increase in incomes and a subsequent increase in the wellbeing of the population (Piabuo & Tieguhong, 2017).

3.3.2.5 Defense (DEF)

Defense spending is the share separated by states from their national income in order to provide security against internal and external threats. Defense spending is composed of the production (or import from other countries) of tools and vehicles used in defense; repair and maintenance; and costs for the tools and vehicles. It also includes expenditure for research and development activities and the military and civilian staff employed in the defense field. Governments arrange the share they separate for defense spending by taking the welfare of their country into consideration and if they feel a threat, they decrease the investments that will increase the welfare of the country and increase defense spending (Korkmaz, 2015).

Based on the neoclassical approach, an increase in defense spending will cause an increase in government expenditure, which will crowd out private investment. This is because if defense expenditure is financed by an increase in taxes, it will lower private savings and, therefore, increase domestic interest rates. Alternatively, defense expenditure is financed by taking loans, which also causes an increase in domestic interest rates since demand for domestic funds will increase for the given supply of domestic funds. This crowding out of private investment causes aggregate supply to reduce, resulting in a reduction in employment and output. The neoclassical model predicts negative effects of defense expenditure on the growth of economy (Ajmir, Hussain, Abbasi, & Gohar, 2018).

The Keynesian view states that increased government spending can raise aggregate demand and increase consumption, which can result in increased production. Based on this view, some scholars argue that increased government expenditure on socio-economic and physical infrastructure encourages economic growth. As such, government expenditure on education and health raises the productivity of labour and increases the growth of national output (Tsadiku, 2012).

3.4 Estimation technique

The Gross Domestic Product measures the value of economic activity within a country. Strictly defined, GDP is the sum of the market values, or prices, of all final goods and services produced in an economy during a period of time. In general, GDP (Y) is the sum of consumer spending (C), investment (I), government purchases (G), and net exports (i.e., export – import) as represented by the equation:

$$Y = C + I + G + NX$$

- Consumer spending, C, is the sum of expenditures by households on durable goods, nondurable goods (e.g., clothing, food, etc), and services *e.g., health care).

- Investment, I, is the sum of expenditures on capital equipment, inventories, and structures (e.g., machinery, unsold products, and housing).

- Government spending, G, is the sum of expenditures by all government bodies on goods and services (e.g., naval ships and salaries to government employees).

- Net exports, NX, equals the difference between spending on domestic goods by foreigners and spending on foreign goods by domestic residents. In other words, net exports describe the difference between exports and imports.

Economic growth is the increase in the market value of the goods and services produced by an economy over time. It can also be defined as the increase in the real output of the country in a specific period of time. The rise in the country's output of goods and services may be caused by an improvement in the quality of education, improvements in technology or in any way if there is a value addition in goods and services which is produced by every sector of the economy.

Economic development is the growth of the standard of living of a nations people from a low-income (poor) economy to a high-income (rich) economy. When the local quality of life is improved, there is more economic development. In other words, it is the increase in the level of production in an economy along enrichment of living standards and the advancement of technology. It is conventionally measured as the percent rate of increase in real gross domestic product, or real GDP. It can also be defined as the process that focuses on both qualitative and quantitative growth of the economy. It measures all the aspects which include people in a country become wealthier, healthier, better educated, and have greater access to good quality housing. Hence, economic development can create more opportunities of education, healthcare, employment and the conservation of the environment.

The standard of living includes various things like safe drinking water, improve sanitation systems, medical facilities, the spread of primary education to improve literacy rate, eradication of poverty, balanced transport networks, increase in employment opportunities etc. The improved quality of living standard is the major indicator of economic development. Therefore, an increase in economic development is more necessary for an economy to achieve the status of a Developed Nation. It can be measured by the Human Development Index, which considers the literacy rates & life expectancy which affect productivity and could lead to Economic Growth.

It is considered that health, education, defense and infrastructure expenditures positively impact on GDP growth and it makes sense to assume that in a particular year; they will cause GDP growth in following years as the investments produce goods and services, provide jobs,

etc. not just in the year of investment but also in years following. Economic growth trickles down to the health sector and the education systems, hence it makes sense to assume a long-run relationship that requires the use of lagged values of GDP in economic development regression models. With a similar reasoning, the current expenditure of health, education, defense and even infrastructure may not affect the current GDP or economic growth, thus requiring the use of lagged values again.

Education is considered to increase life satisfaction in less developed countries through the positive impact it has on health improvement and health expenditure per capita (Guisan, 2009). This therefore would bring about a collinearity between education government expenditure and health government expenditure.

The main objective of the study is to investigate the impact of public spending on economic growth in BRICS in the following specific areas: education, health, defense and infrastructure. The study did not investigate the factors that affect economic development variables such as population growth and size. Government expenditure on defense might be influenced by political instability or stability in the country, etcetera, which were not considered. However, these variables should have been controlled by including them in the regression model to improve on the model specification to avoid biasing the results. There are some variables that were omitted in the GDP multiple regression model due to secondary data limitations.

To examine the impact of public spending on economic growth, panel data analysis was done of real GDP, education, health, defense and infrastructure from 1994 to 2014 to analyse the data. This included both the fixed effects model and the random effect model.

The Breusch and Pagan Lagrange multiplier test or the Hausman test can indicate if a random effect model should be used instead of the pooled ordinary least squares (OLS) method. In this study, the Hausman test was used to find out whether the fixed effects model or the random effect model should be used to obtain valid results. For fixed effects regression, one can also use the F-test to find out whether the fixed effects model should be used instead of a pooled OLS model. The pooled OLS estimation is simply an OLS technique run on panel data and all individually specific effects are completely ignored. The reason for this is that many basic assumptions such as orthogonality of the error term are violated. Random error solves this problem by implementing an individual-specific intercept in the regression model, which is assumed to be random. This implies full exogeneity of the model, which can be tested with the

Hausman test. Since almost every model has some endogeneity issues, the fixed effects estimation is the best choice and gives the most consistent estimates, but the individual-specific parameters vanish.

There are two issues with a fixed effects model. These are heterogeneity and contemporaneous correlation of errors across states of the panel. The former can be checked using the F-test after estimation. The latter issue can be addressed, for example, by performing the Lagrange multiplier test of Breusch and Pagan. This test requires that the number of years be greater than the number of states, which was the case for this study. (Breusch and Pagan, 1979). Hence, the data of 21 years and five states met this requirement. The basic postulate is that the number of observations must be greater than the number of independent variables which, in this study, consisted of four: health, education, defense and infrastructure. There were five sets of observations for five different states, namely, Brazil, Russia, India, China and South Africa. Therefore, the regression could be run to check for the problems in variables such as heteroscedasticity, multicollinearity and autocorrelation for simple analysis.

3.4.1 Fixed effect versus random effect models

Panel data models examine fixed and/or random effects of entity (group) or time. The core difference between fixed and random effect models lies in the role of dummy variables (Table 1). If dummies are considered as a part of the intercept, this is a fixed effect model. In a random effect model, the dummies act as an error term (Allison, 2009). A fixed group effect model examines group differences in intercepts, assuming the same slopes and constant variance across entities or subjects. Since a group (individual-specific) effect is time invariant and considered a part of the intercept, *i u* is allowed to be correlated to other independent variables. Fixed effect models use the least squares dummy variable (LSDV) and within effect estimation methods. OLS regressions with dummies, in fact, are fixed effect models.

Table 1: Comparison of fixed effect and random effect models

Function form	**Fixed effect model**	**Random effect model**
Functional form	$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_p X_p + \varepsilon$	$X_1, X_2, ..., X_p$
Intercepts	Varying across groups and/or times	Constant
Error variances	Constant	Varying across groups and/or times
Slopes	Constant	Constant
Estimation	LSDV, within effect method	GLS, FGLS

Hypothesis test	Incremental F-test	Breusch-Pagan LM test

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_p X_p + \varepsilon$$

Source: Park (2009)

3.5 Endogeneity

In econometrics, one of the most important OLS assumptions is that the errors are uncorrelated with the dependent variables in regression models. In a multiple linear regression, if at least one of the regressors is correlated with the residual, then the exogeneity assumption (E(u|x) = 0) is violated. We say that the regression suffers from endogeneity problem. Endogenous variables have values that are determined by other variables in the system. For example, in the data set used in this study, economic growth or GDP can also impact on government spending. Other possible reasons for the endogeneity problem are measurement error and omitted variables.

In the presence of endogeneity, OLS can produce biased and inconsistent parameter estimates. In the econometric analysis done for this study, there is a possibility of endogeneity (reverse causality) but with a small sample size and limited dataset with a few variables, we could not test for it. There was a high possibility that there were omitted variables, that is, those which determine economic growth and government spending (such as private consumption, gross investment, government investment, population growth and size, inflation, etcetera) but were not included in the data set. Secondary data were used in this study and we could not obtain data on all such variables, otherwise, they would have been controlled by including them in the regression model. This might have caused a bias problem and inconsistent parameter estimates.

The best way to deal with endogeneity concerns would have been through instrumental variables (IV) techniques but it was not possible to use instrumental variables because the data used were limited. The only thing that could be done was to use lags. As we estimate successive lags, there are fewer degrees of freedom left, making statistical inference somewhat unstable. In the same vein, including too few lags would lead to specification errors. The data set used in this study was short, which might have had an effect in this regard. Also, in economic time series data, successive lagged values tend to be highly correlated increasing the likelihood of multicollinearity in the model. This would lead to imprecise estimation, that is, the standard errors tend to be inflated in relation to the estimated coefficients.

CHAPTER 4: DISCUSSION OF FINDINGS

4.1 Introduction

The foregoing chapter described and explained the research methods employed in this study to answer the research questions. Data collection and data analysis methodologies were examined. In this chapter, the results are presented and discussed. The chapter consists of four sections. After the introduction, section two includes the descriptive statistical analysis, followed by inferential statistical analysis; section three presents the results and the last section discusses the results and concludes the chapter.

4.2 Descriptive statistical analysis

Table 2 presents the mean values of the key study variables for the individual countries. There are big differences in GDP and government spending on health, education, defense and infrastructure between the countries. In general, Russia has the highest mean figures and RSA has the lowest. The highest mean figure is $3500.3 trillion (std. dev. = 3179.6) (Russia) and the lowest is $236.5 trillion (std. dev.=102.8) (RSA) for GDP. The highest mean figure is $171.4 trillion (std. dev.=150.0) (Russia) and the lowest is $.4 trillion (std. dev. = .3) (RSA) for Health. The highest mean figure is $65.4 trillion (std. dev.=48.5) (Brazil) and the lowest is $13.1 trillion (std. dev. = 6.4) (RSA) for Education. The highest mean figure is $84.6trillion (std. dev.=54.4) (Russia) and the lowest is $2.7 trillion (std. dev. = .4) (RSA) for Defense. The highest mean figure is $25.7 trillion (std. dev.=23.3) (Brazil) and the lowest is $2.3 trillion (std. dev. = 3.7) (RSA) for Infrastructure.

The results indicate that of all the BRICS countries, Russia has the biggest economy and South Africa is associated with the smallest ecomomy. Russia (mean GDP = $3500.3 trillion) has the highest economic growth by far – compared to the other BRICS countries and might therefore have dominated the results of the panel analysis, thus biasing the conclusions of the study. Apart from infrastructure spending and education, Russia's government spending on health and defense is the highest of all.

Table 2: Mean values of the study key variables for each country

GDP (in Trillion USD)			
	Frequency	Mean	Std. Dev.
Brazil	21	1259.6	759.2
China	21	955.8	736.0
India	21	939.9	593.5
Russia	21	3500.3	3179.6
RSA	21	236.5	102.8
Total	**105**	**1378.4**	**10.6**
Health (in Trillion USD)			
	Frequency	Mean	Std. Dev.
Brazil	21	99.0	62.5
China	21	61.2	52.3
India	21	40.9	27.0
Russia	21	171.4	150.0
RSA	21	.4	.3
Total	**105**	**746.0**	**57.9**
Education (in Trillion USD)			
	Frequency	Mean	Std. Dev.
Brazil	21	65.4	48.5
China	21	35.1	27.4
India	21	34.8	23.0
Russia	21	62.7	56.6
RSA	21	13.1	6.4
Total	**105**	**42.2**	**31.9**
Defense (in Trillion USD)			
	Frequency	Mean	Std. Dev.
Brazil	21	19.4	4.3
China	21	32.8	13.4
India	21	34.2	11.3
Russia	21	84.6	54.4
RSA	21	2.7	.4
Total	**105**	**29.9**	**22.4**
Infrastructure (in Trillion USD)			
	Frequency	Mean	Std. Dev.
Brazil	20	25.7	23.3
China	20	4.3	6.2
India	21	21.6	28.2
Russia	21	10.0	5.6
RSA	14	2.3	3.7
Total	**96**	**15.6**	**12.3**

The following Figure 1 shows panel-data line graphs for individual countries. In general, there is a rising trend for GDP between 1994 and 2014. The data for Russia increased the most between 1994 and 2014. Also, Russia is associated with the highest figures for GDP and South Africa has the lowest. The trend of the GDP for South Africa is almost zero, that is, values

stayed more or the same level between the years. Apart from South Africa, for health, education and defense, there is a rising trend for government spending between 1994 and 2014. In general, Russia has the highest positive trends of government spending over the years.

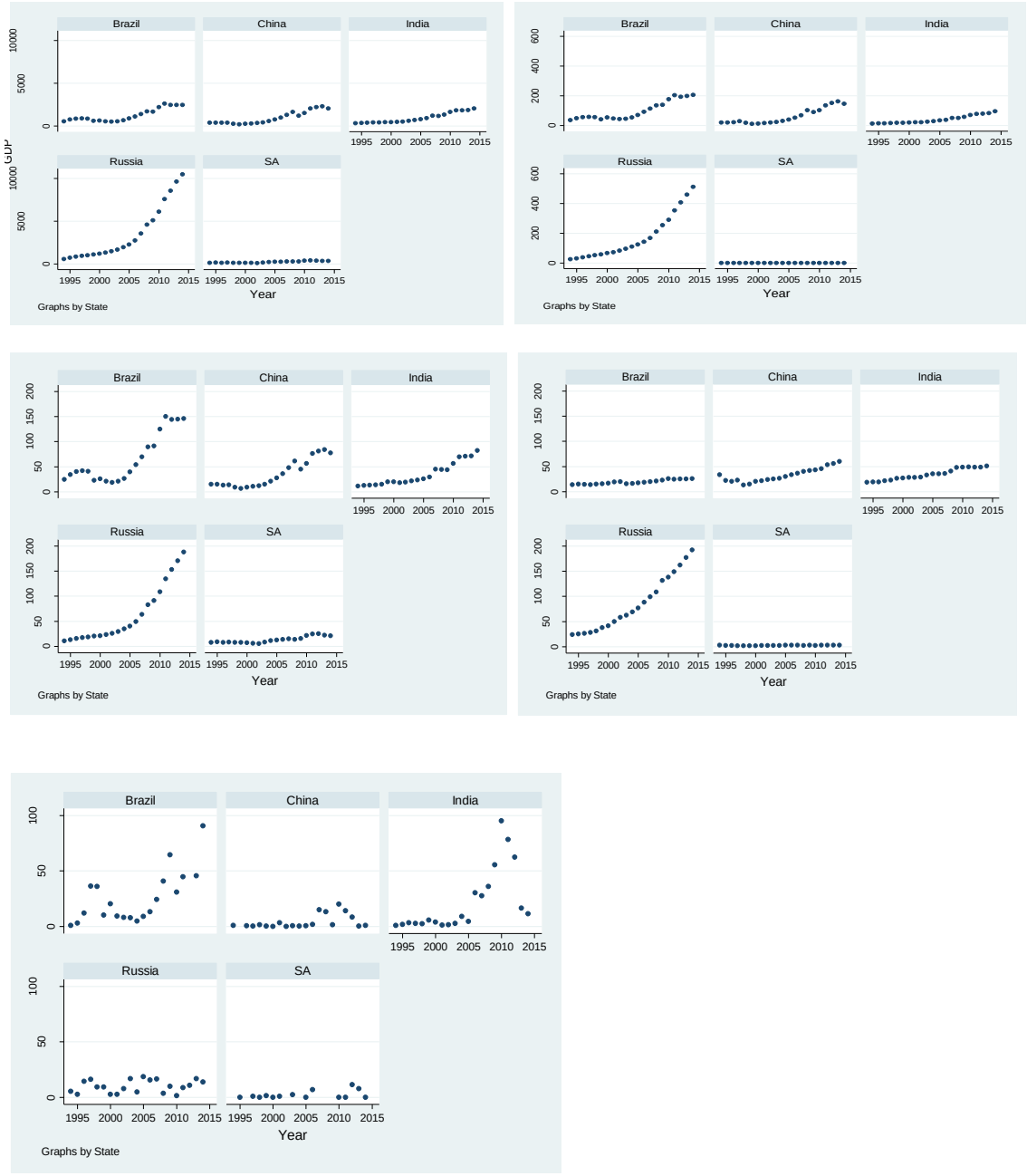

Figure 1: Panel-data line graphs for individual countries

For government spending on infrastructure, the time plots for Brazil and India are different from those of China, Russia an RSA. Government spending increased sharply after around 2005 for Brazil and India reaching relatively very high figures in 2014 for Brazil but around 2010 for India then went down. For China, Russia and RSA, the figures remained more or less

the same between the 1994 and 2014 at low figures – with a zero trend. This information might imply that Russia might have dominated the results of the panel analysis and therefore biased the conclusions and recommendations.

Figure 2 shows a panel-data time plot. In the figure, 1 = Brazil, 2 = China, 3 = India, 4 = Russia and 5 = RSA. The figure indicates a positive trend for all the independent variables. This implies that as GDP is increasing government spending on health, education, defense and infrastructure also increase.

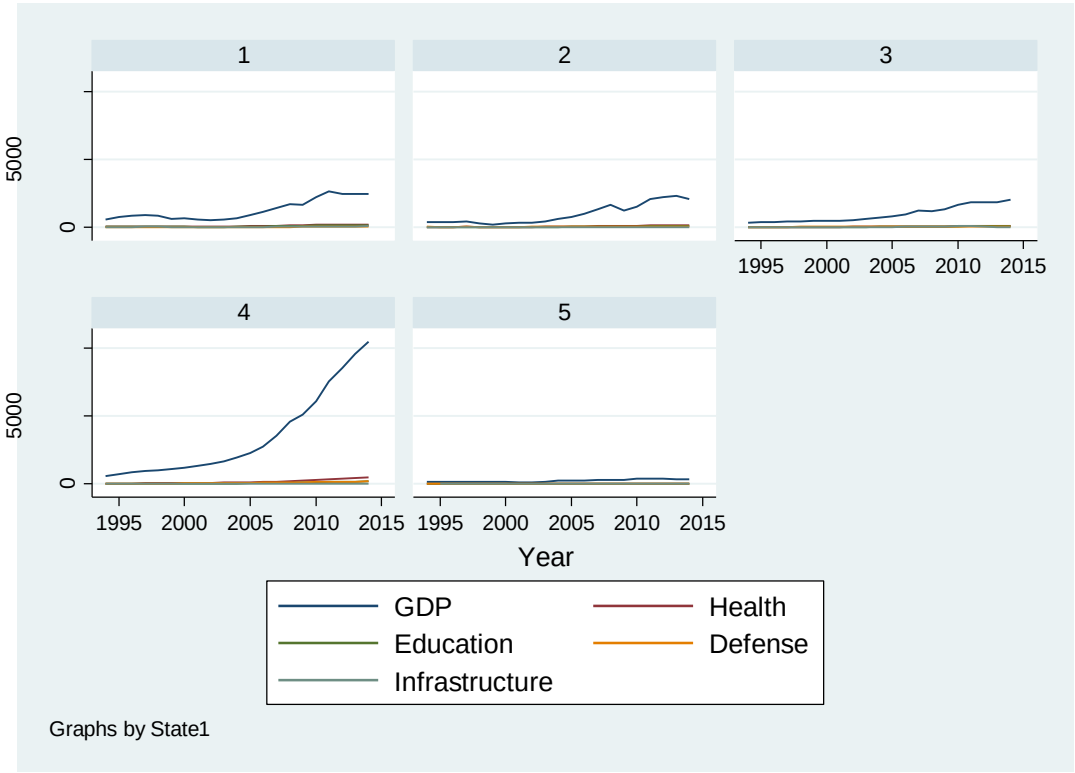

Figure 2: Panel -data time plot

The figures of the variables were aggregated to summarise them for the BRICS countries bloc. Table 3 presents the average values of the variables in trillion US dollars. As expected, GDP ($1378.4 trillion) figures are the highest, then health ($746.0 trillion), then education ($42.2 trillion).

Table 3: Average values of the study variables

	GDP	Health	Education	Defense	Infrastructure
Average	$1378.4	$746.0	$42.2	$29.9	$15.6
Standard deviation	$10.6	$57.9	$31.9	$22.4	$12.3
Median	$1865.2	$457.8	$23.8	$25.1	$12.2
Minimum	$1157.5	$249.0	$5.9	$18.8	$13.7
Maximum	$1048.2	$511.0	$187.9	$191.9	$47.7
Observations	105	105	105	105	105

4.3 Regression results

Panel data analysis was used to investigate the long-term relationship between GDP, and health, education, defense and infrastructure. State (countries) was used as the panel variable. LogGDP was fitted on health, education defense and infrastructure in the regression models. It should be noted that, in order to use the Hausman test to choose between the fixed effects model and the random effects model, first, both models had to be fitted and secondly, their stored residuals had to be used in the test. The results of the Hausman test indicate that the fixed effects model should be used as the null hypothesis (Ho) that the difference in coefficients between fixed effects model and random effects model are not statistically was rejected (Prob>χ^2<0) to accept the alternative hypothesis that the difference in coefficients between fixed effects model and random effects model are systematic. The results of the fixed effects model were the valid results for this study and were, therefore, the results that were interpreted. The fixed results are presented for the both level and lag variables of all the independent variables. From Table 4, we observe positive effects of health, education, defense and infrasturture expenditure on economic growth, with significance achieved for all except infrastructure at 1%. In addition, the lag effect of health and defense were observed to be greater than the level or instantaneous effects.

Table 4: Fixed effects models

	Level Equation			Lag Equation		
	Coef.	**Std. Err.**	**t**	**Coef.**	**Std. Err.**	**t**
Constant	5.280***	0.219	24.15	5.755***	0.494	11.66
Log(Health)	0.062***	0.021	3.02			
L1. Log(Health)				0.100**	0.027	3.76
Log(Education)	0.741***	0.028	26.4			
L1. Log(Education)				0.625***	0.066	9.45
Log(Defense)	0.279***	0.034	8.17			
L1. Log(Defense)				0.427***	0.075	5.73
Log(Infrastructure)	0.001	0.002	0.51			
L1. Log(Infrastructure)				0.003	0.009	0.3
F	3097.26***			984.44***		
R-Squared	0.9929			0.9511		
Hausman χ^2	-34.83***			96.16***		
Hettest χ^2	0.50			0.04		
Prob > χ^2	0.4814			0.8444		
A(1): F	114.705***			114.705***		
Countries	5			5		
Observations	105			100		

Note: Hausman=Hausman test for fixed or random effects: Hettest=Heteroskedasticity test; AR(1)=autocorrelation test. *** and ** denotes significance at 1% and 5% respectively.

4.3.1 Dealing with the multicollinearity problem

Multicollinearity refers to a situation where two or more explanatory (predictor) variables in a multiple regression model are related with each other and likewise related with the response variable. There is perfect multicollinearity if, for example as in the equation above, the correlation between two independent variables is equal to 1 or −1. In practice, we rarely find perfect multicollinearity in a data set. More commonly, the issue of multicollinearity arises when there is an approximate linear relationship among two or more independent variables (Akinwande, Dikko, & Samson, 2015).

When the independent variables or predictors of the dependent variable are highly correlated, one might have a multicollinearity problem in regression analysis. This problem affects the coefficients of the variables concerned. It occurs when there are high correlations among predictor variables, leading to unreliable and unstable estimates of regression coefficients – by inflating their standard errors. In this study, variance inflation factors (VIFs) were used to detect the multicollinearity problem. This problem may cause a coefficient to be insignificant because its standard error is inflated when the coefficient should actually be significant. For example, a VIF of 1.7 indicates that the variance, that is, the square of the standard error of a particular

coefficient, is 70% larger than it would be if that predictor was completely uncorrelated with all the other predictors. The VIF has a lower bound of 1 but no upper bound. A VIF greater than 3 is likely to be causing a problem of biasing the coefficient concerned.

The best way to deal with the multicollinearity problem is to drop an independent variable. However, since this study aims to identify the relationship between each of the independent variables with GDP, stepwise regression was applied. Stepwise regression is used to select a subset of independent variables from a large number of variables that account for most of the variation in the dependent variable. In this procedure, the independent variables are entered or removed from the regression model one at a time. All the independent variables were included in the regression model and the estimated VIFs are presented in Table 5.

Table 5: VIF test for model 1

Variable	**VIF**
Health	7.925
Education	2.325
Defense	5.633
Infrastructure	1.410

The results indicate that the coefficients of health and defense are likely to have been affected by multicollinearity. When health was not included in the model, the VIFs dropped to below 3 (Table 6); hence, a regression analysis with education, defense and infrastructure as independent variables would not be affected by multicollinearity.

Table 6: VIF test for model 2

Variable	**VIF**
Education	1.861
Defense	1.753
Infrastructure	1.298

Based on the above-mentioned results, there is no possibility of having a multicollinearity problem; thus, the coefficients of the independent variables have not been biased by it. The regression results based on the VIF test in Table 5 (model 1) are presented in Table 7. Based on the Hausman specification test, the model was estimated using the random effects technique.

The Prob > χ^2 indicates that the model is significant at the 1% level. The r-square of 0.992 and 0.9392 means that 99.2% and 93.92% of the variation in economic growth were explained by the level and lag models respectively.

From the regression results presented in Table 7, the coefficients of education and defense are observed to be significant at 1%. The positive coefficients observed for the level and lag education (B=.801, B=0.731; p=.000<.001) and the level and lag LogDefense (B=.284, B=0.424; p=.000<.001) indicate that increases in education and military expenditure among BRICS countries stimulate economic growth. Some studies, such as that of Benoit (1973) and Dash, Bal, and Sahoo (2016), have found a two-causality between defense expenditure and economic growth. Much research done on the relationship between education and economic growth indicates that there is a positive relationship (for example, Hanushek & Woessmann, 2010, Barro, 1997, Barro, 2001, Benhabib & Spiegel, 1994). The results of infrastructure indicate that it does not have a relationship with economic growth because its coefficient is not significant (B=.001, p=.713>0.1). The estimated coefficient for infrastructure expenditure was not significant, indicating that infrastructure had no relationship with economic growth over the study period.

Table 7: Random effects – model 2

	Level Equation			**Lag Equation**		
	Coef.	**Std. Err**.	**Z**	Coef.	Std. Err.	z
Constant	5.267***	0.228	23.07	5.626***	0.639	8.81
Log(Education)	0.801***	0.02	39.1			
L1. Log(Education)				0.731***	0.037	19.82
Log(Defense)	0.284***	0.036	7.99			
L1. Log(Defense)				0.424***	0.054	7.89
Log(Infrastructure)	0.001	0.002	0.37			
L1. Log(Infrastructure)				0.002	0.009	0.24
Waldχ^2	3781.43***			2004.66***		
R-Squared	0. 992			0.9329		
Hausman	0.14			5.08		
Hettest χ^2	3.11			0.9		
A(1): F	115.788***			115.788***		
Countries	5			5		
Observations	105			100		

Note: Hausman=Hausman test for fixed or random effects: Hettest=Heteroskedasticity test; AR(1)=autocorrelation test. *** and ** denotes significance at 1% and 5% respectively.

When defense was not included in the model, the VIFs dropped below 3 (Table 8). Hence, a regression analysis with health, education and infrastructure would not be affected by multicollinearity.

Table 8: VIF test for model 3

Variable	**VIF**
Health	2.466
Education	2.306
Infrastructure	1.378

The r-square of 0.988 and 0.876 means that 98.8% and 87.6% of the variation in economic growth were explained by the level and lag models respectively. Based on the results in Table 9, the regression analysis for model 3 with health, education and infrastructure as the independent variables are estimated. The level and lag LogHealth (B=.071; B=0.104; p=0.010<.05) and level and lag LogEducation (B=.875, B=0.833; p=.000<.001) are significant and LogInfrastructure (B=-.001, B=0.001; p=.679>.1) is not significant. This implies that health and education expenditure increase GDP, which is due to the fact that health and education are factors of human capital which have a positive relationship with labour productivity. The implication is that the more or better educated and the healthier people are, the more productive they will become and the higher the GDP will be. This result is consistent with the findings of Schultz (1961) and Lee and Barro (1997).

Table 9: Random effects – model 3

	Level Equation			**Lag Equation**		
LogGDP	**Coef.**	**Std. Err.**	**z**	Coef.	Std. Err.	Z
Constant	4.685***	0.272	17.24	4.923***	0.673	7.31
Log(Health)	0.071**	0.027	2.63			
L1.Log(Health)				0.104**	0.047	2.2
Log(Education)	0.875***	0.03	29.14			
L1.Log(Education)				0.833***	0.056	14.79
Log(Infrastructure)	-0.001	0.003	-0.41			
L1.Log(Infrastructure)				0.001	0.007	0.13
Wald	2361.96***			1419.81***		
R-Squared	0.988			0.876		
Hausman χ^2	0.2			0.12		

Hettest χ^2	22.72**	13.02***
A(1): F	124.169***	124.169
Countries	5	5
Observations	105	100

Note: Hausman=Hausman test for fixed or random effects: Hettest=Heteroskedasticity test; AR(1)=autocorrelation test. *** and ** denotes significance at 1% and 5% respectively.

CHAPTER 5: CONCLUSION

5.1 Introduction

The penultimate chapter was a discussion on the findings of this study. This chapter presents a summary of the findings, the conclusion and recommendations based on the data analysed in the previous chapter.

5.2 Summary of the research

The purpose of this study was to investigate the impact of public spending on economic growth empirically, using GDP as the dependent variable and health, education, defense and infrastructure expenditures as the independent variables. The analysis process began with summarising the data using descriptive statistics. The descriptive statistics provided information on the data's mean, standard deviation, median, minimum and maximum values. A process of regression analysis in order to determine the relationships between GDP and health, education, defense and infrastructure followed this. Multicollinearity was checked for using variance inflation factors (VIFs) and the Hausman test was applied to find out whether the fixed effects or the random effect model should be used.

The findings of the study indicate a failure to reject the null hypothesis that expenditure on education, health and defense has a positive impact on economic growth in the long run in BRICS. In the case of infrastructure, the study rejects the null hypothesis that infrastructure has a positive impact on and a strong correlation with economic growth in BRICS. As the results further suggest, health, education and defense have a long-term relationship with GDP. There is no long-term relationship between infrastructure and GDP.

Investment funds should be channelled mostly in areas such as health and education. A healthy and educated nation is key to the fostering of economic growth and development. In addition, investment in a country's defense projects is necessary to ensure that the citizens as well as the resources of the country are protected from external forces that might threaten the country's stability. Interestingly, the findings did not indicate a long-term relationship between infrastructure investment and economic growth. Therefore, spending in this area should be properly investigated to ensure that it will yield the desired results; otherwise, the expense will be wasteful and funds should rather be reallocated to areas that will enhance economic growth.

5.3 Recommendations

The study did not investigate other factors of economic growth and development such as population growth and size, inflation and political instability or stability in a country. However, these variables should have been controlled by including them in the regression model to improve on the model specification to avoid biasing the results.

There was also a possibility of endogeneity (reverse causality) but with a small sample size and limited dataset with a few variables, we could not test for it in this study. The best way to deal with endogeneity concerns would have been through instrumental variables (IV) techniques but it was not possible to use instrumental variables because the data used were limited. The only thing that could be done was to use lags. The problem though, was that there was no way we could gauge whether the solution was adequate to deal with it. Causality analysis and autocorrelation were not done for this study because the Stata version that was used could not be used to investigate them. This might have caused a bias problem and inconsistent parameter estimates.

We therefore suggest that further studies should be done for each BRICS countries using a large sample size; and in these studies, all the variables that are considered theoretically to affect economic growth and economic development should be included in the regression model to be controlled; “omitted variables” should be avoided. Causality analysis or endogeneity (reverse causality) should be dealt with and autocorrelation should be investigated.

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